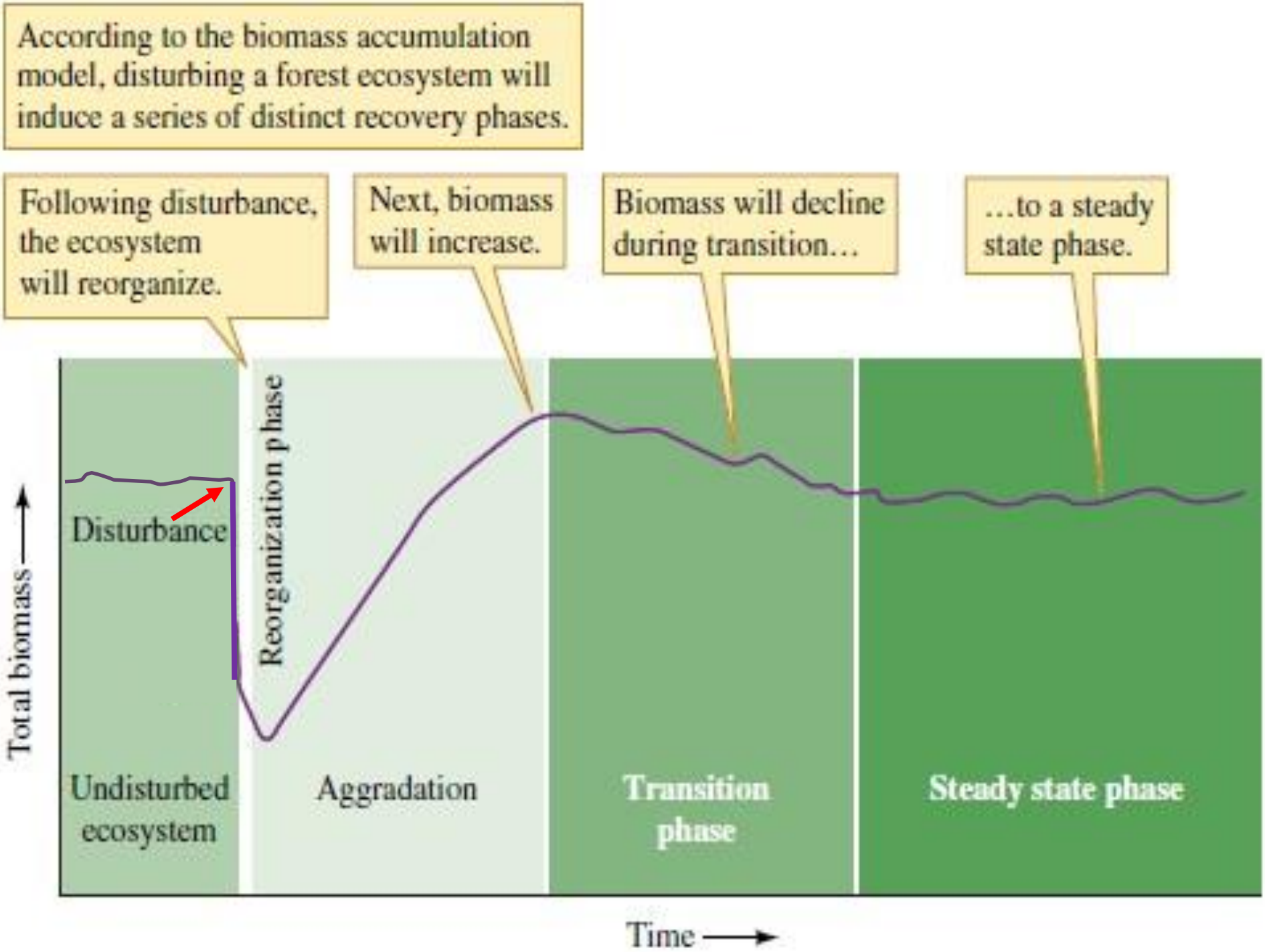
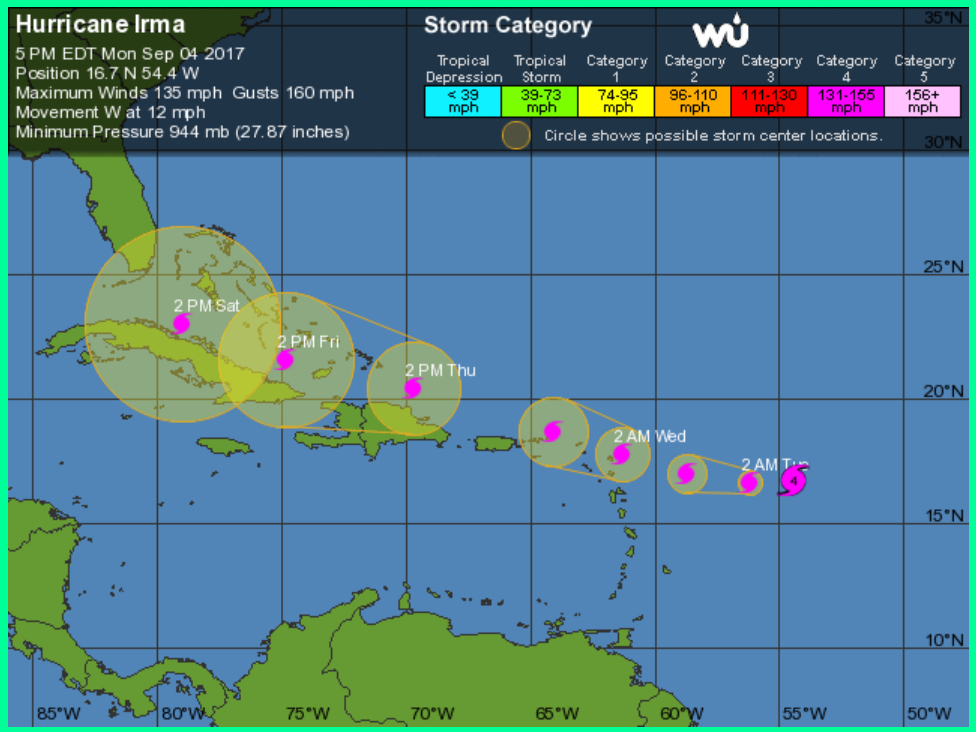
Hurricane Impacts on Natural Ecosystems

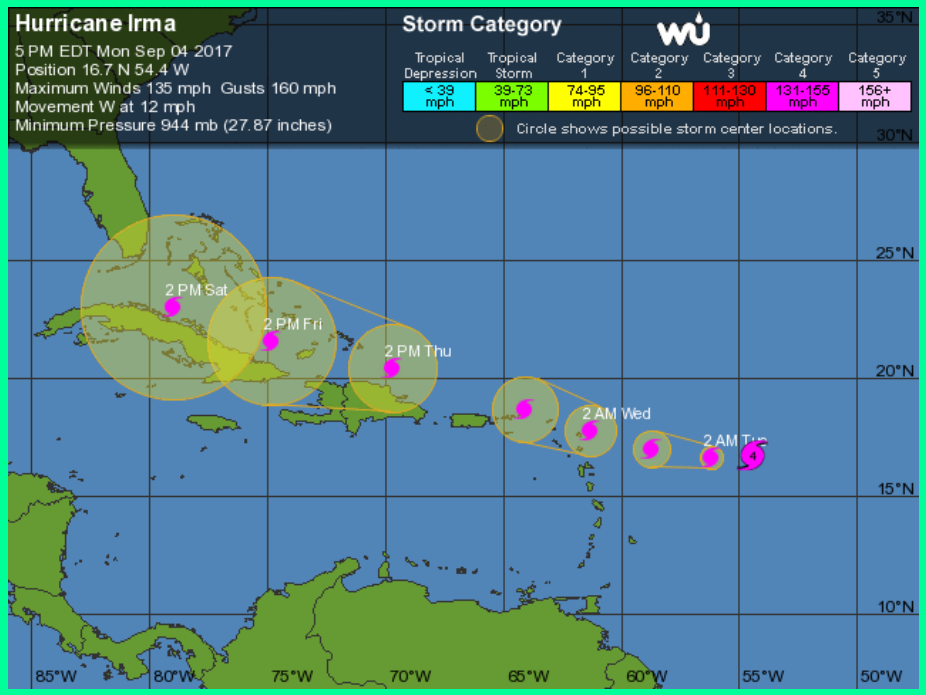
Win Everham
Florida Gulf Coast University
February 2, 2018


According to the biomass accumulation model, disturbing a forest ecosystem will induce a series of distinct recovery phases.
Following disturbance, the ecosystem will reorganize.
Next, biomass will increase.
Biomass will decline during transition…
…to a steady state phase.
Disturbance
Reorganization phase
Total biomass
Undisturbed ecosystem
Aggradation
Transition phase
Steady state phase
Time

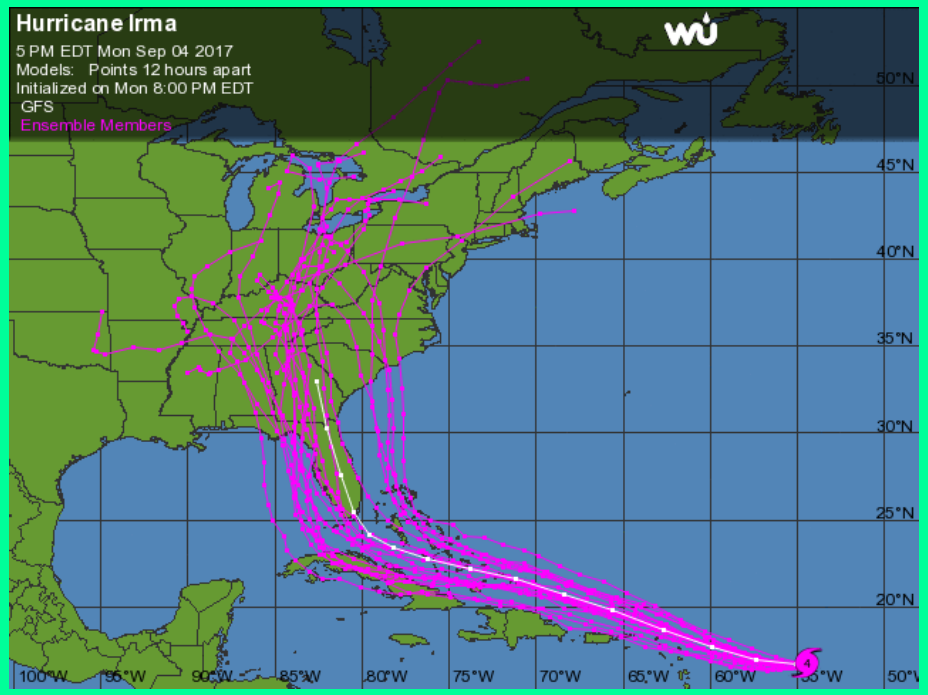
Five Day Projection – Monday September 4



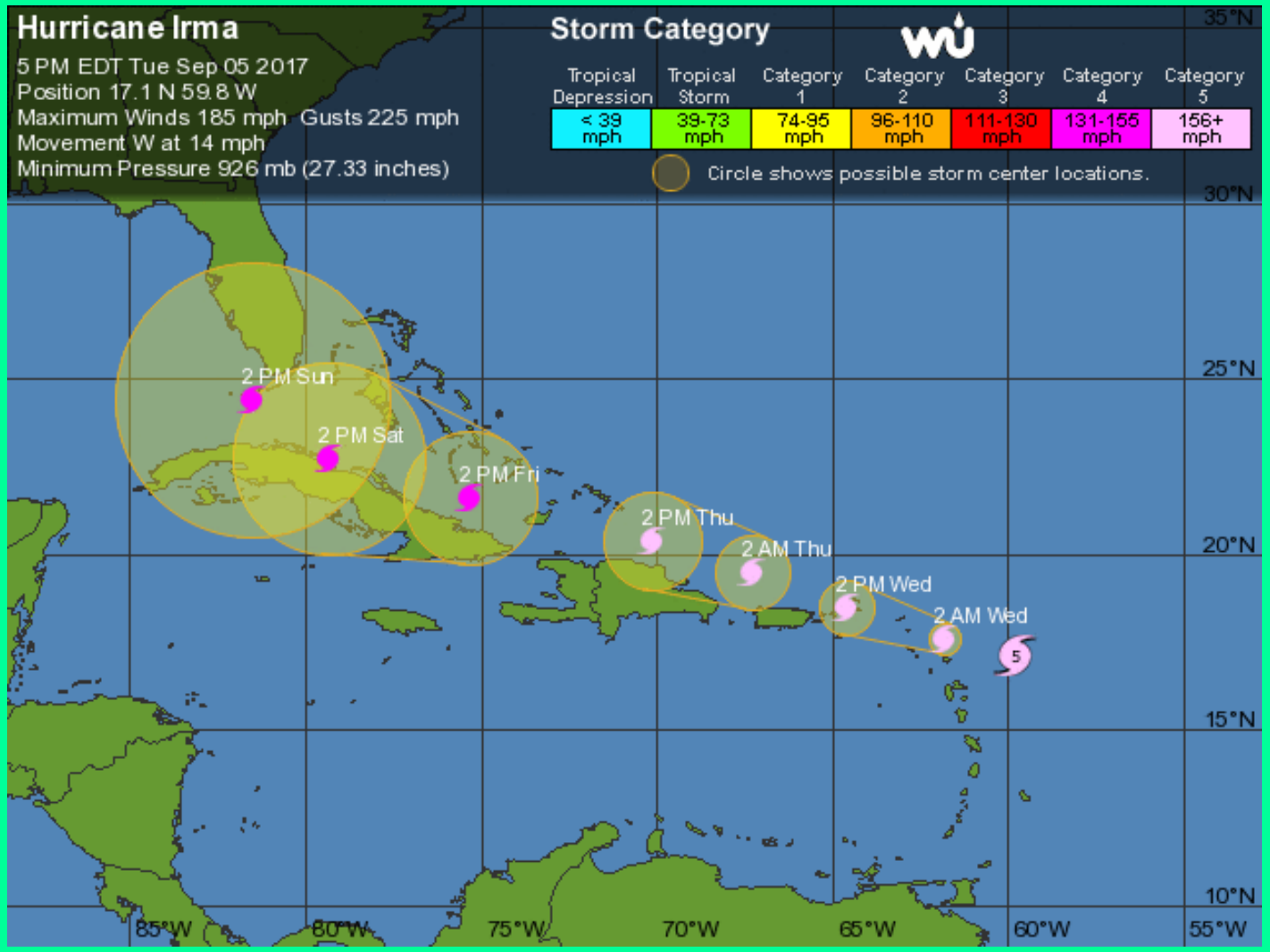
Five Day Projection – Monday September 4



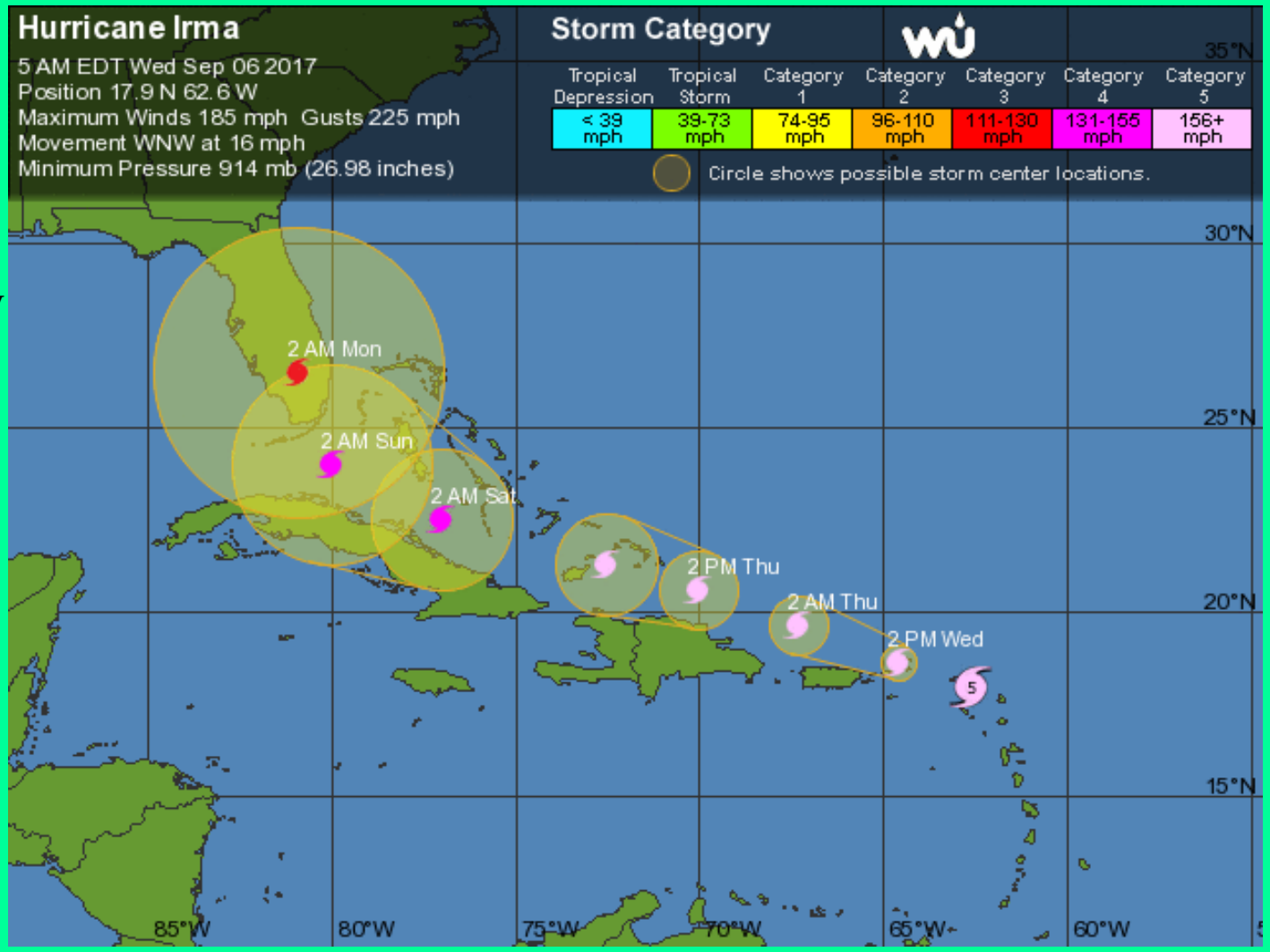
Longer term model projection – Monday September 4



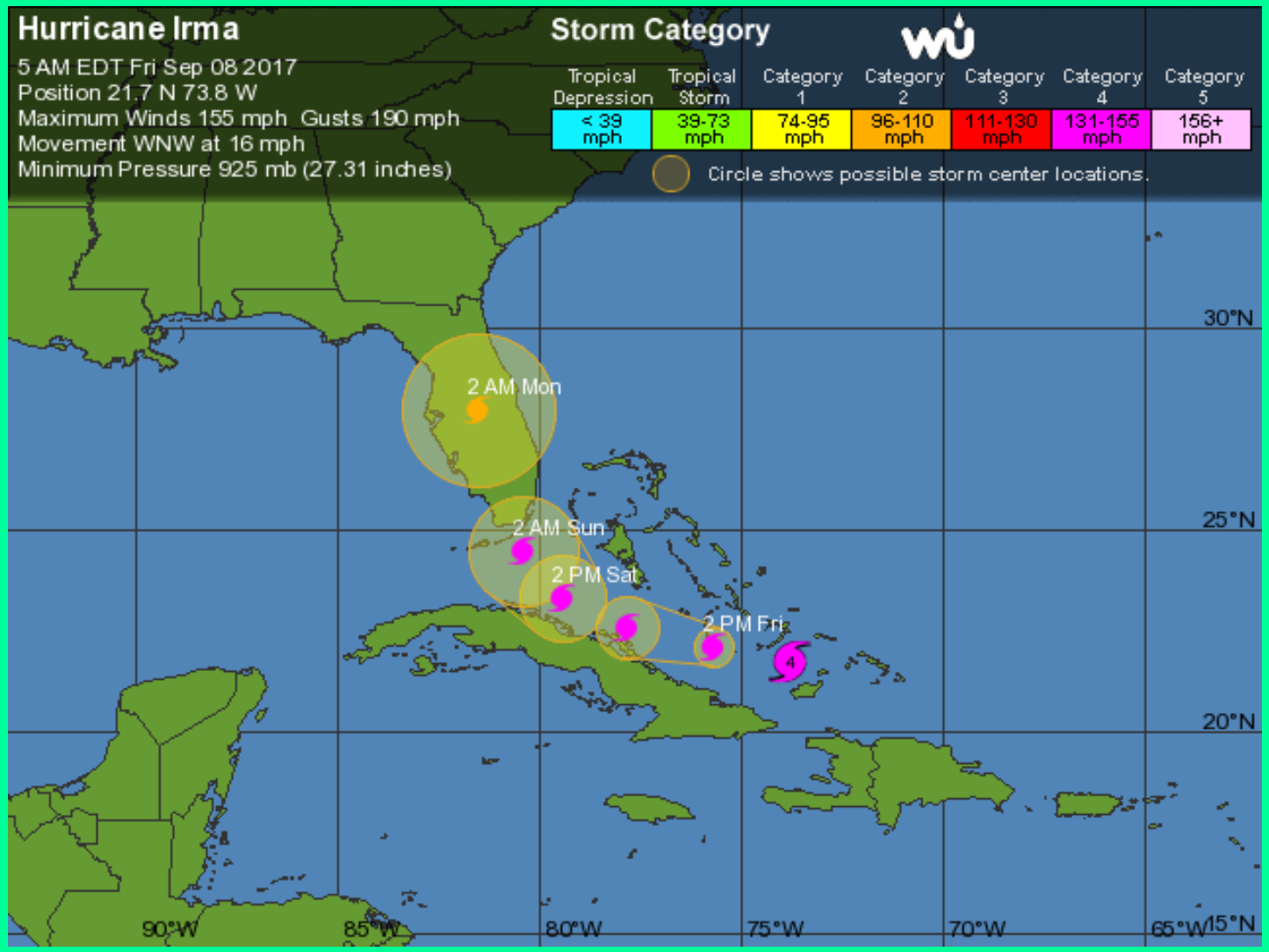
Tuesday
9/5


Hurricane Irma
5 PM EDT Tue Sep 05 2017
Position 17.1 N 59.8 W
Maximum Winds 185 mph Gusts 225 mph
Movement W at 14 mph
Minimum Pressure 926 mb (27.33 inches)
Storm Category
Tropical Depression
Tropical Storm
Category 1
Category 2
Category 3
Category 4
Category 5
< 39 mph
39-73 mph
74-95 mph
96-110 mph
111-130 mph
131-155 mph
156+ mph
Circle shows possible storm center locations.
2 PM Sun
2 PM Sat
2 PM Fri
2 PM Thu
2 AM Thu
2 PM Wed
2 AM Wed
5
35°N
30°N
25°N
20°N
15°N
10°N
85°W
80°W
75°W
70°W
65°W
60°W
55°W

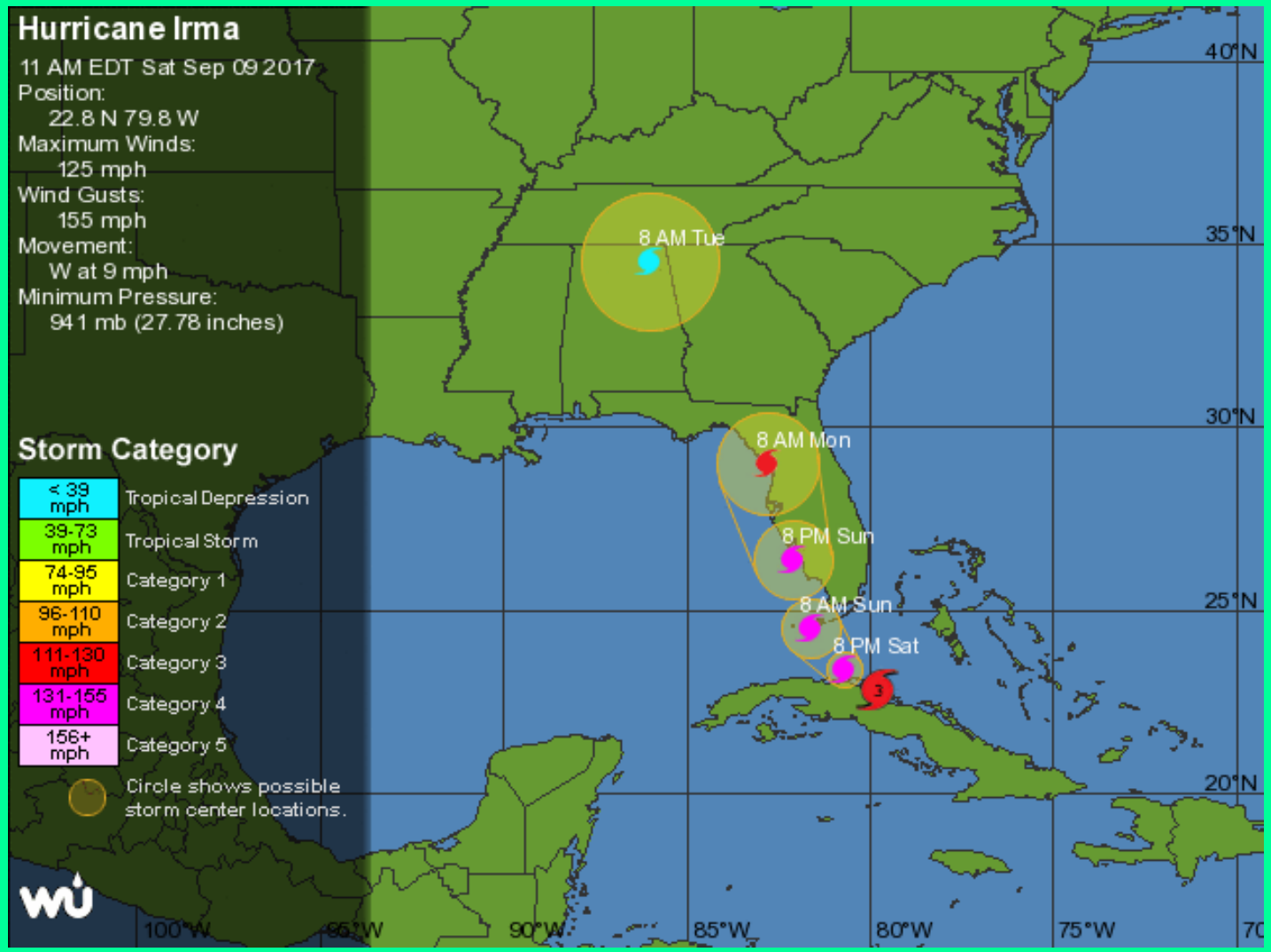
Wednesday
9/6



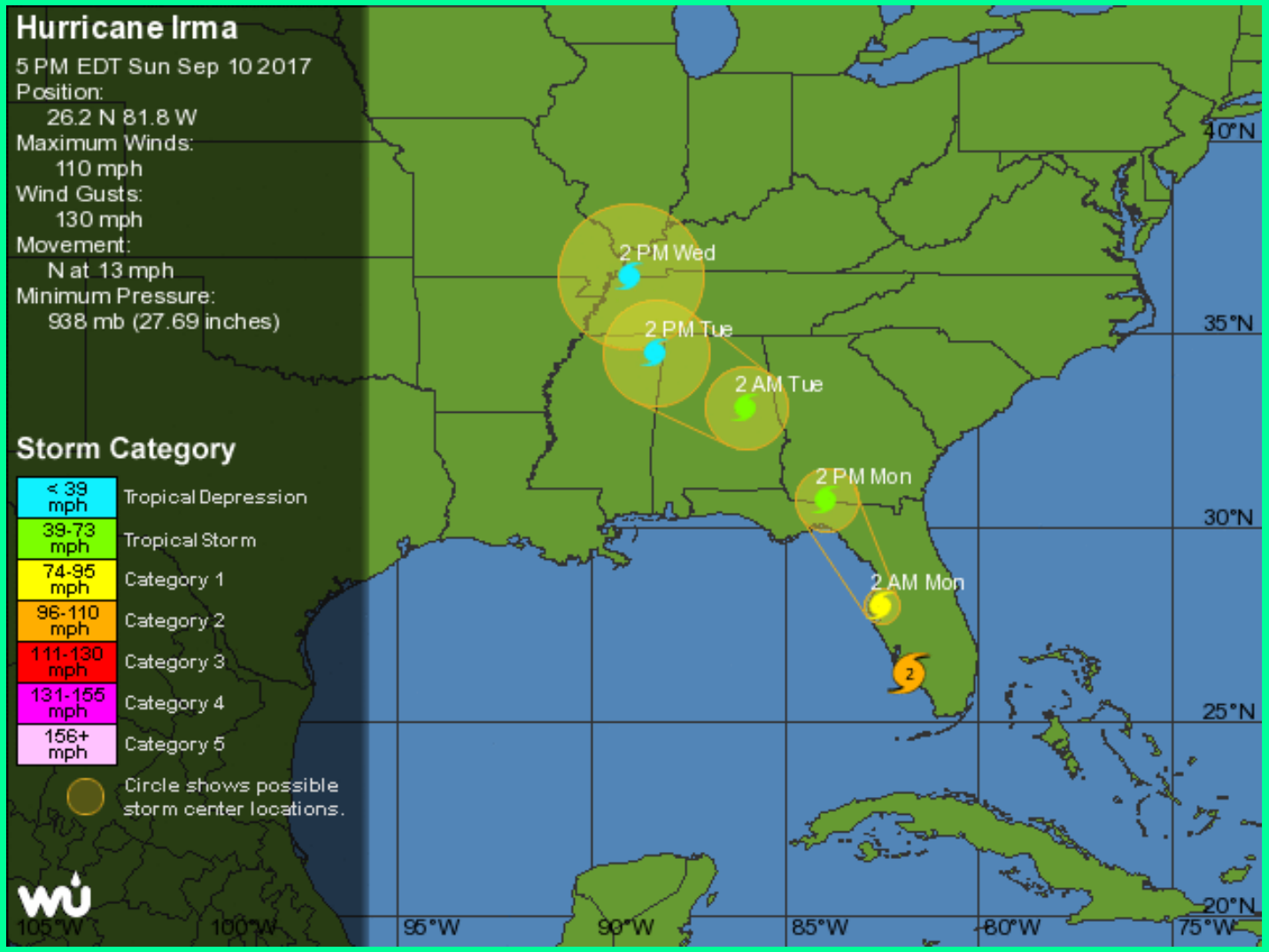
Friday
9/8


Hurricane Irma
5 AM EDT Fri Sep 08 2017
Position 21.7 N 73.8 W
Maximum Winds 155 mph Gusts 190 mph
Movement WNW at 16 mph
Minimum Pressure 925 mb (27.31 inches)
Storm Category
Tropical Depression
< 39 mph
Tropical Storm
39-73 mph
Category 1
74-95 mph
Category 2
96-110 mph
Category 3
111-130 mph
Category 4
131-155 mph
Category 5
156+ mph
Circle shows possible storm center locations.
2 AM Mon
2 AM Sun
2 PM Sat
2 PM Fri
30°N
25°N
20°N
15°N
90°W
85°W
80°W
75°W
70°W
65°W

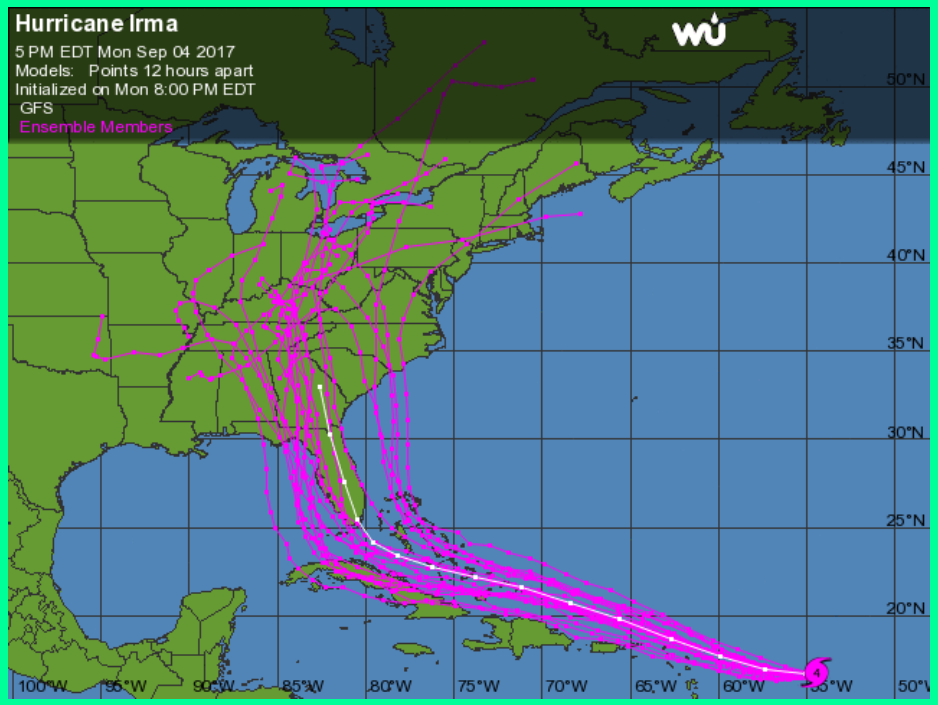
Saturday
9/9


Hurricane Irma
11 AM EDT Sat Sep 09 2017
Position:
22.8 N 79.8 W
Maximum Winds:
125 mph
Wind Gusts:
155 mph
Movement:
W at 9 mph
Minimum Pressure:
941 mb (27.78 inches)
Storm Category
< 39 mph
Tropical Depression
39-73 mph
Tropical Storm
74-95 mph
Category 1
96-110 mph
Category 2
111-130 mph
Category 3
131-155 mph
Category 4
156+ mph
Category 5
Circle shows possible storm center locations.
8 AM Tue
8 AM Mon
8 PM Sun
8 AM Sun
8 PM Sat
3
40°N
35°N
30°N
25°N
20°N
100°W
95°W
90°W
85°W
80°W
75°W

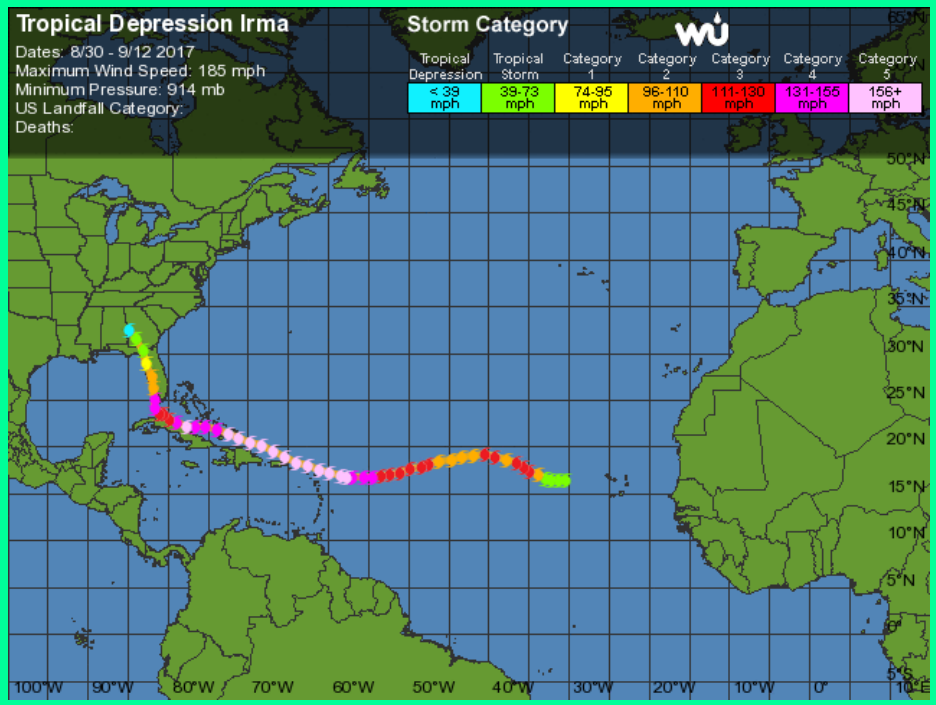
Sunday
9/5
5 PM

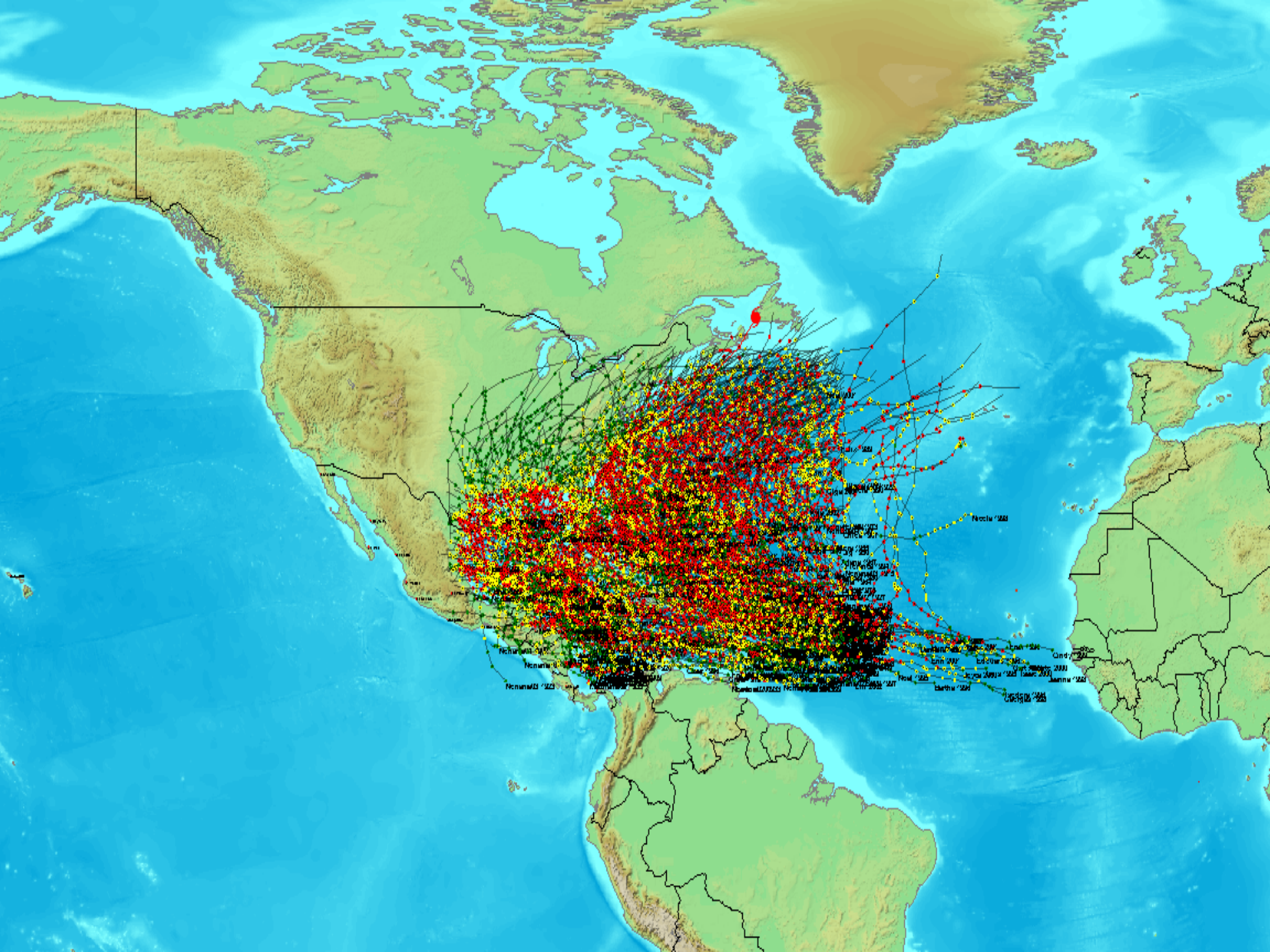


Longer term model projection – Monday September 4



Final Track Data – downloaded Monday 9/18





NOAA Summary

- "It is premature to conclude that human activities–and particularly greenhouse gas emissions that cause global warming–have already had a *detectable* impact on Atlantic hurricane or global tropical cyclone activity."
- "Anthropogenic warming by the end of the 21st century will likely cause tropical cyclones globally to be more intense on average (by 2 to 11% according to model projections for an IPCC mid-range scenario)."
- "Tropical cyclone rainfall rates will likely increase in the future due to anthropogenic warming and accompanying increase in atmospheric moisture content. Models project an increase on the order of 10-15% for rainfall rates averaged within about 100 km of the storm center by the end of the 21st century."
- https://www.gfdl.noaa.gov/global-warming-and-hurricanes/

Pine upland – FGCU Campus

December 2003

March 2004

June 2004
(5 days after burn)

July 2004
(six weeks after burn)

October 2004
(19 weeks after burn)

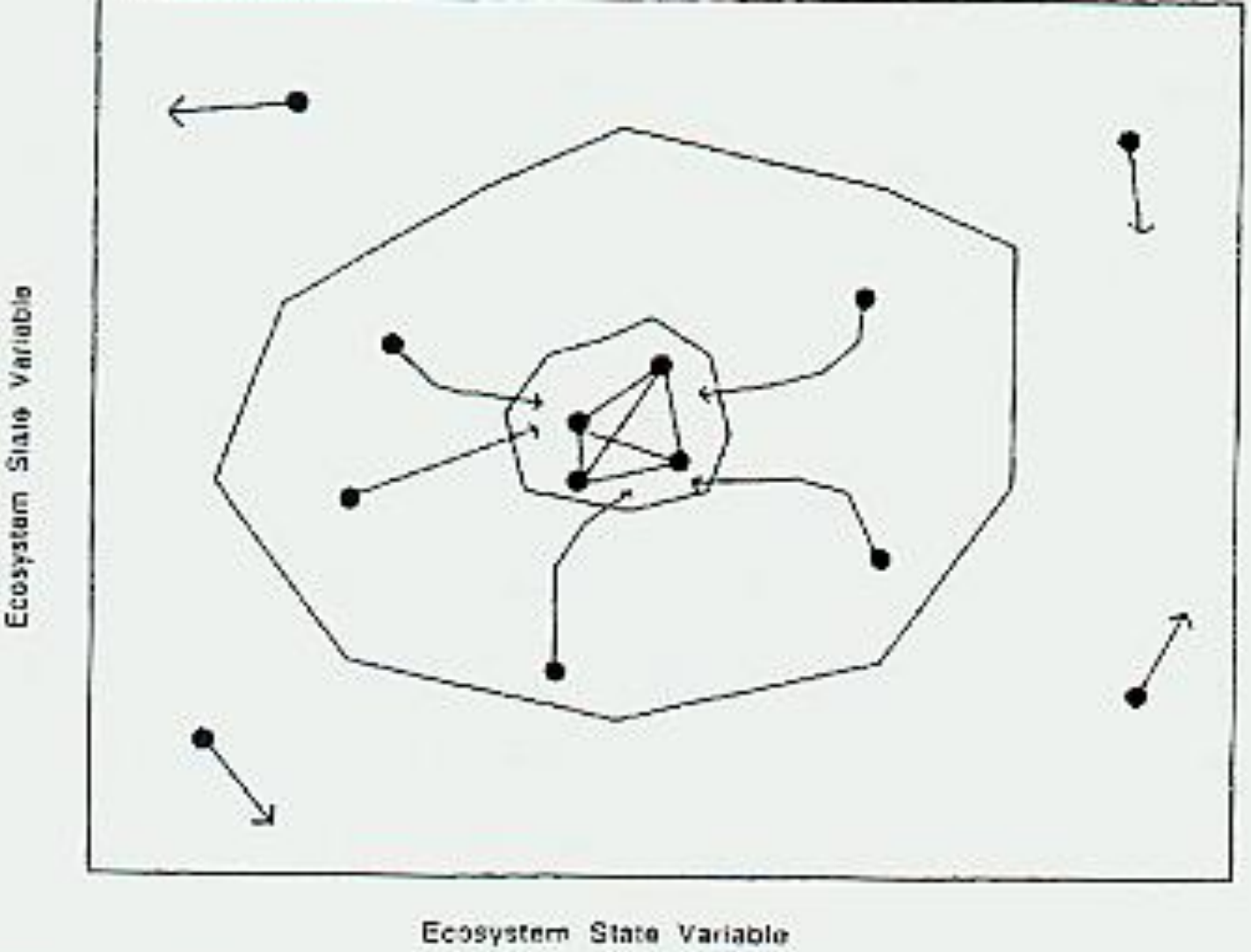


Figure 2 - Margalef's mapping of stability. Axes are state variable values. Area A is the region within which the variable values vary naturally. When stress results in displacements within area B, the system can return to the original state. With displacements outside of B the system seeks new stable points. (after Margalef 1969)

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Forest Damage and Recovery from Catastrophic Wind

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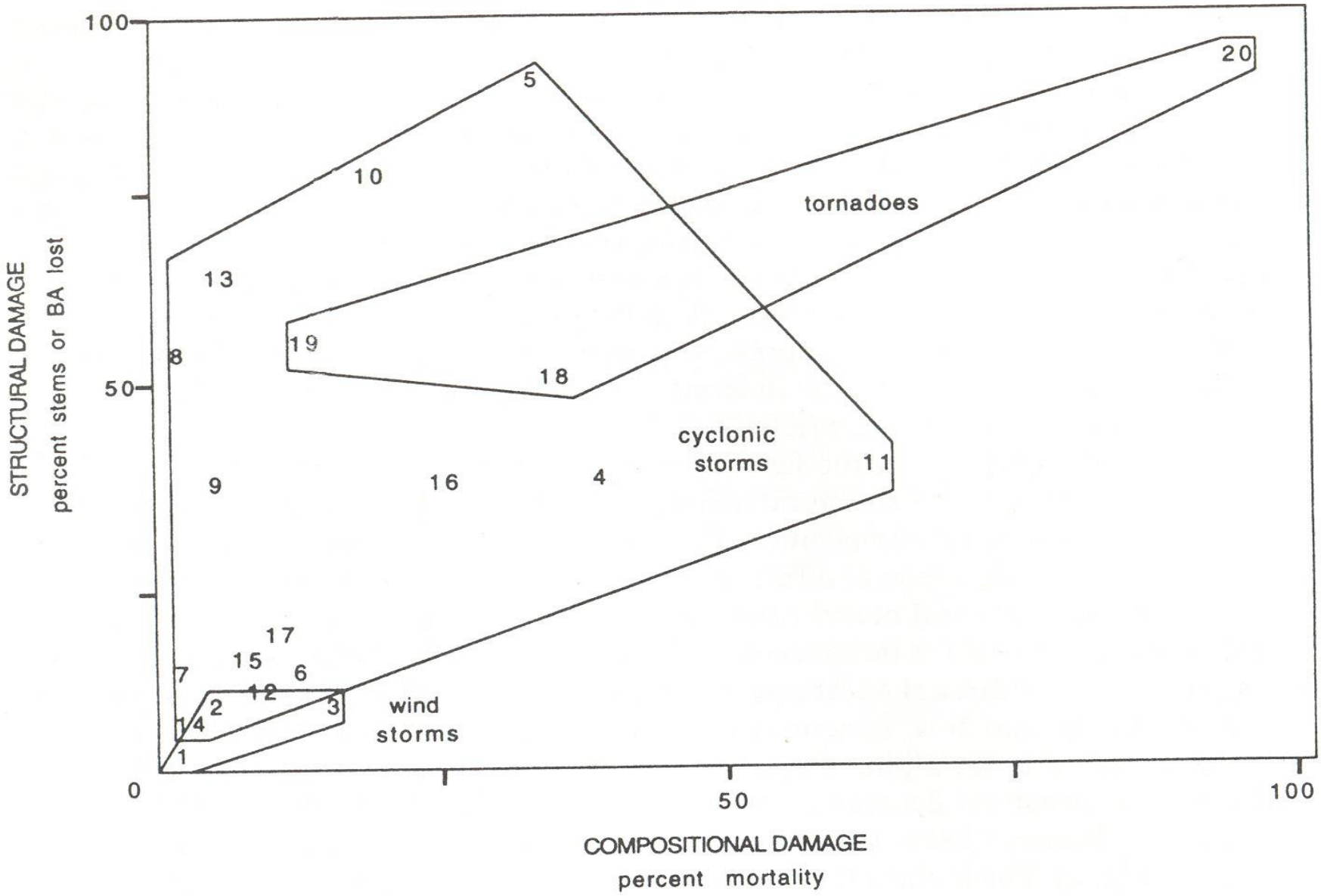
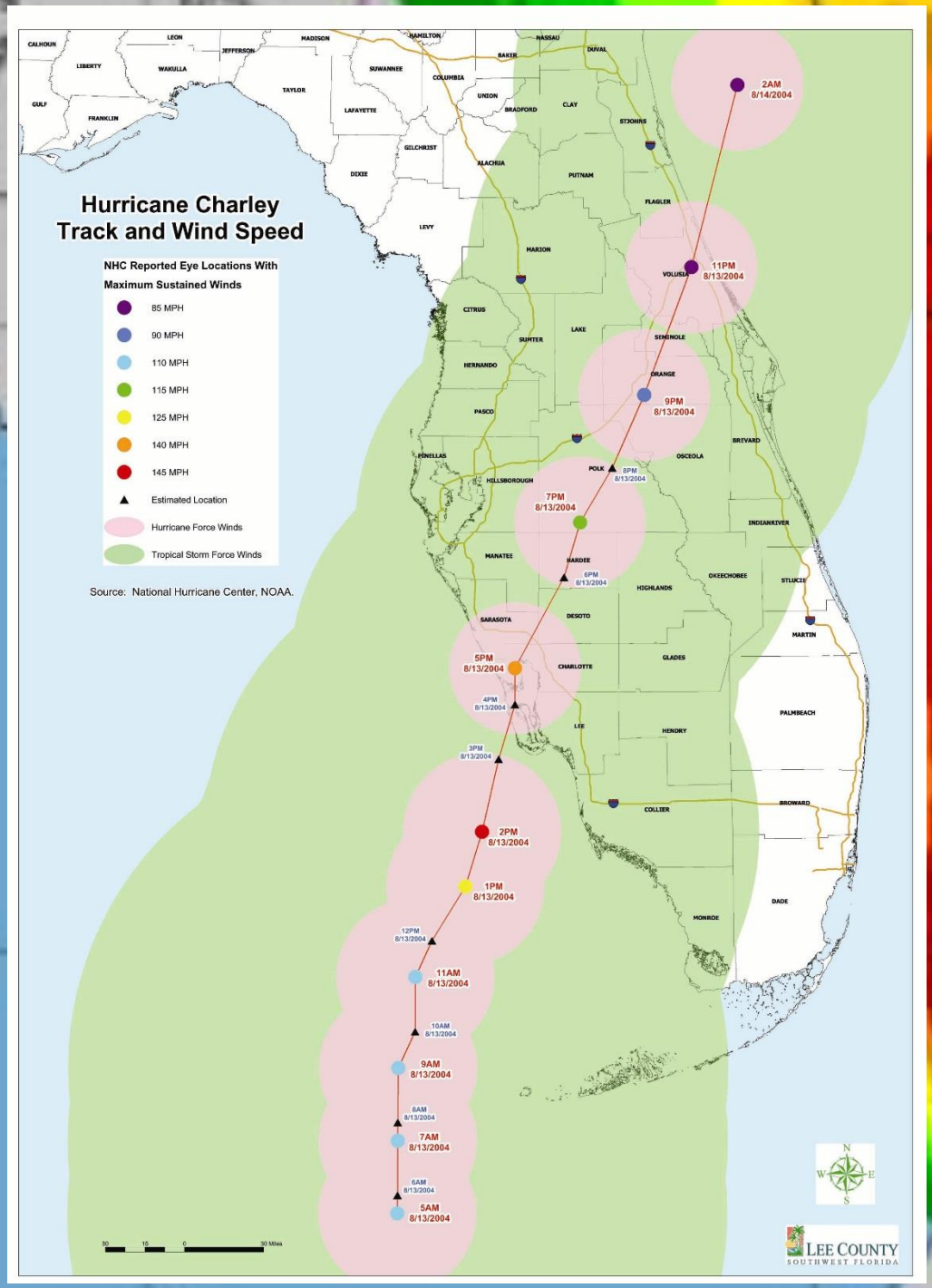
Manomet Observatory for Conservation Sciences
Box 1770
Manomet, Massachusetts 02345, USA

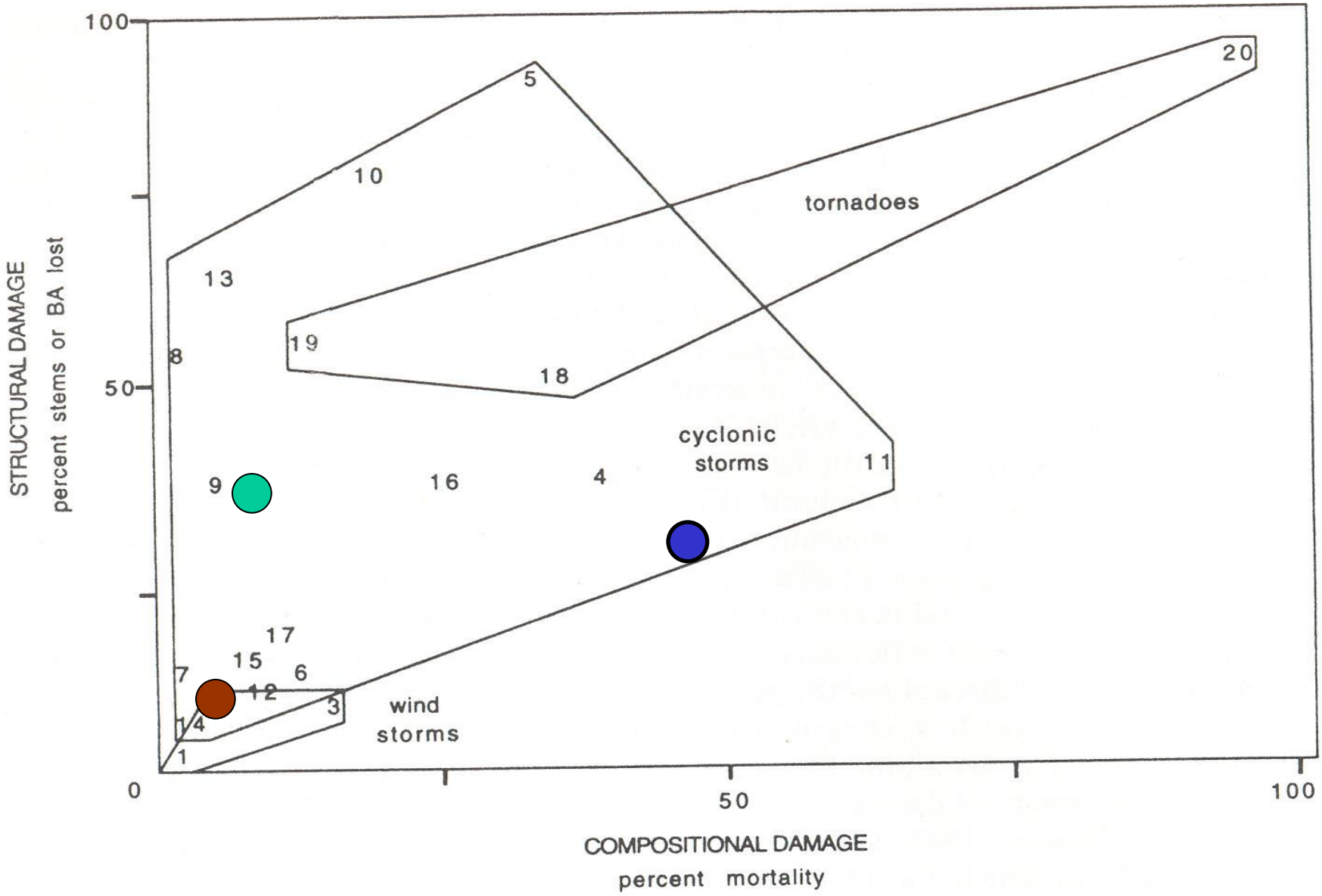
- mortality will be low, but will be delayed
- species will be impacted differently
- the impacts will be heterogeneous
- recovery will be rapid
- exotic species will be more impacted than natives

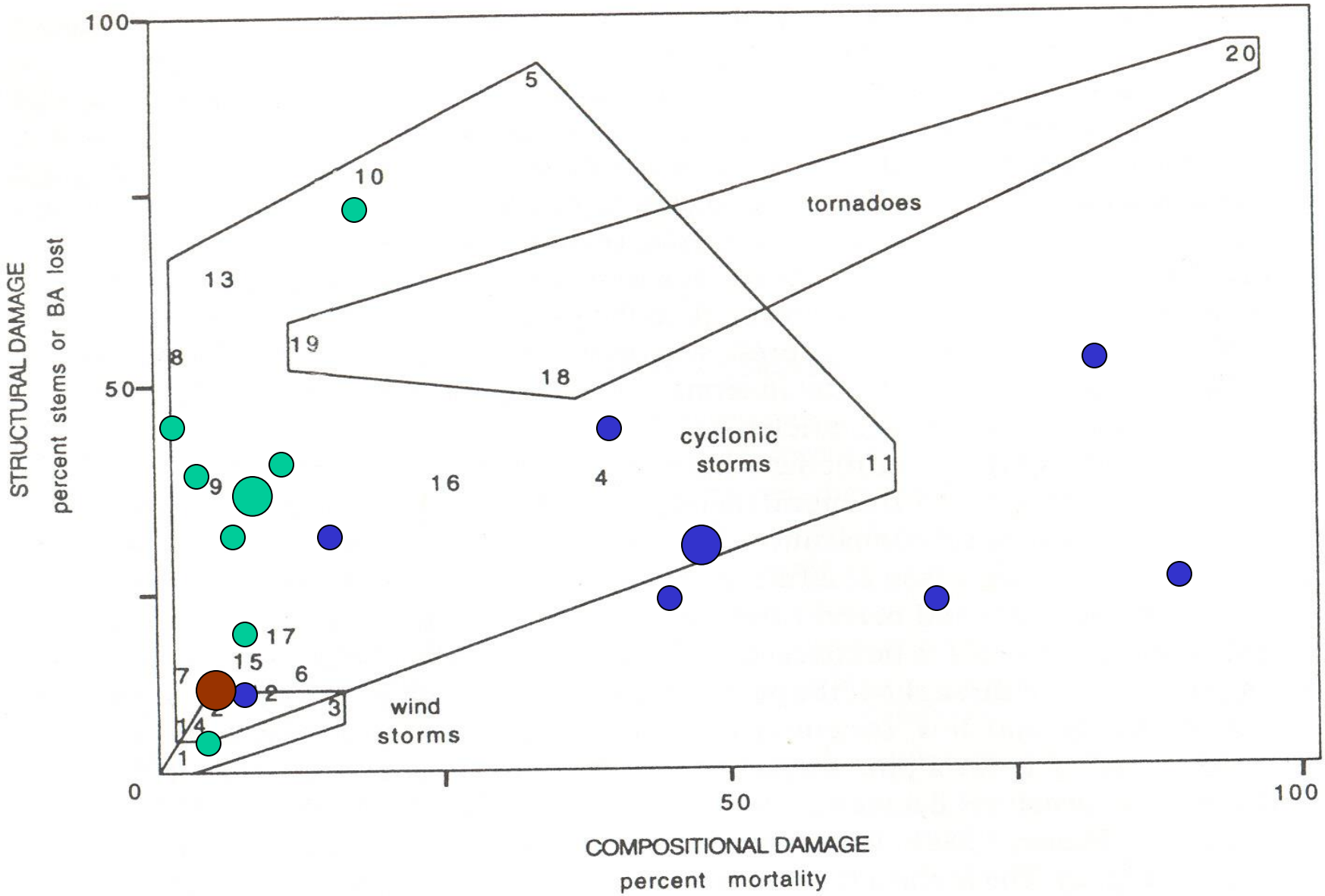

100
50
0
50
100
STRUCTURAL DAMAGE
percent stems or BA lost
COMPOSITIONAL DAMAGE
percent mortality
tornadoes
cyclonic
storms
wind
storms
1
2
3
4
5
6
7
8
9
10
11
12
13
15
16
17
18
19
20

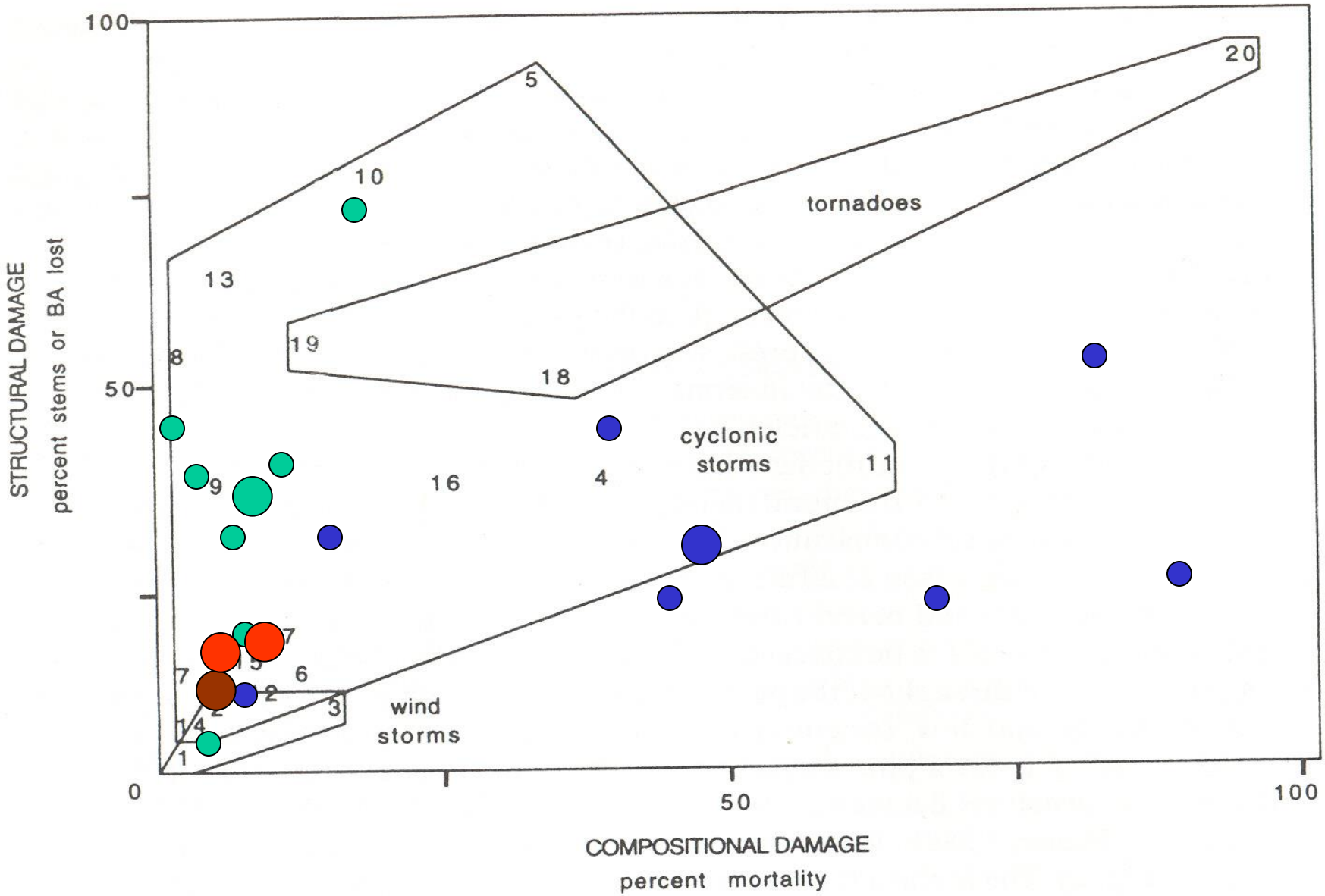

d


f


Hurricane Charley
Track and Wind Speed
NHC Reported Eye Locations With
Maximum Sustained Winds
85 MPH
90 MPH
110 MPH
115 MPH
125 MPH
140 MPH
145 MPH
Estimated Location
Hurricane Force Winds
Tropical Storm Force Winds
Source: National Hurricane Center, NOAA.
2AM 8/14/2004
11PM 8/13/2004
9PM 8/13/2004
8PM 8/13/2004
7PM 8/13/2004
6PM 8/13/2004
5PM 8/13/2004
4PM 8/13/2004
3PM 8/13/2004
2PM 8/13/2004
1PM 8/13/2004
12PM 8/13/2004
11AM 8/13/2004
10AM 8/13/2004
9AM 8/13/2004
8AM 8/13/2004
7AM 8/13/2004
6AM 8/13/2004
5AM 8/13/2004
LEE COUNTY
SOUTHWEST FLORIDA


100
50
0
STRUCTURAL DAMAGE
percent stems or BA lost
5
10
20
tornadoes
13
19
8
18
cyclonic
storms
11
9
16
4
17
15
6
7
12
3
wind
storms
14
1
50
100
COMPOSITIONAL DAMAGE
percent mortality


100
50
0
STRUCTURAL DAMAGE
percent stems or BA lost
50
100
COMPOSITIONAL DAMAGE
percent mortality
tornadoes
cyclonic
storms
wind
storms
1
2
3
4
5
6
7
8
9
10
11
13
15
16
17
18
19
20


100
50
0
STRUCTURAL DAMAGE
percent stems or BA lost
COMPOSITIONAL DAMAGE
percent mortality
50
100
tornadoes
cyclonic
storms
wind
storms
1
2
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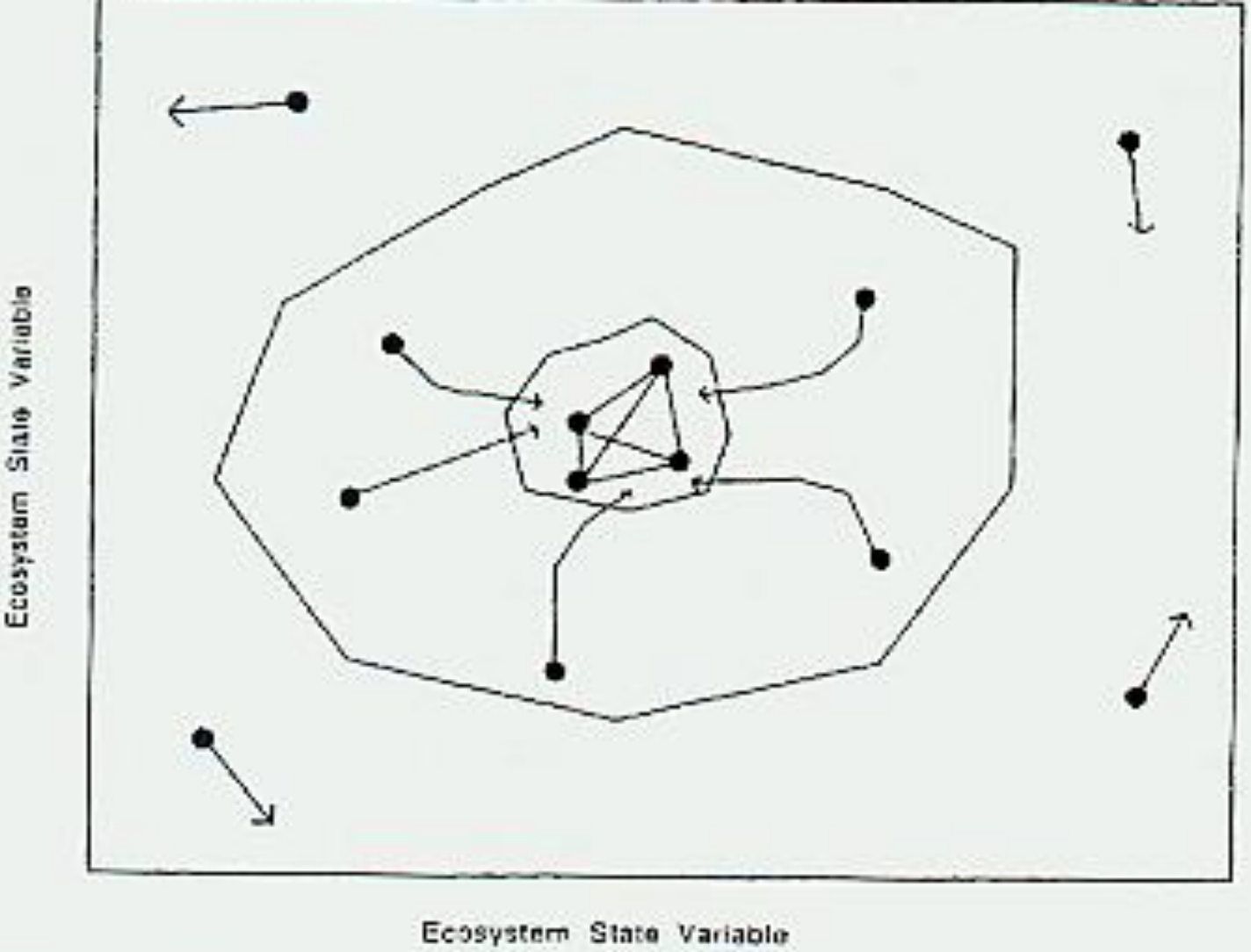
19
20


NOT FOR BROADCAST***
ING CONTACT
ormsnow.com



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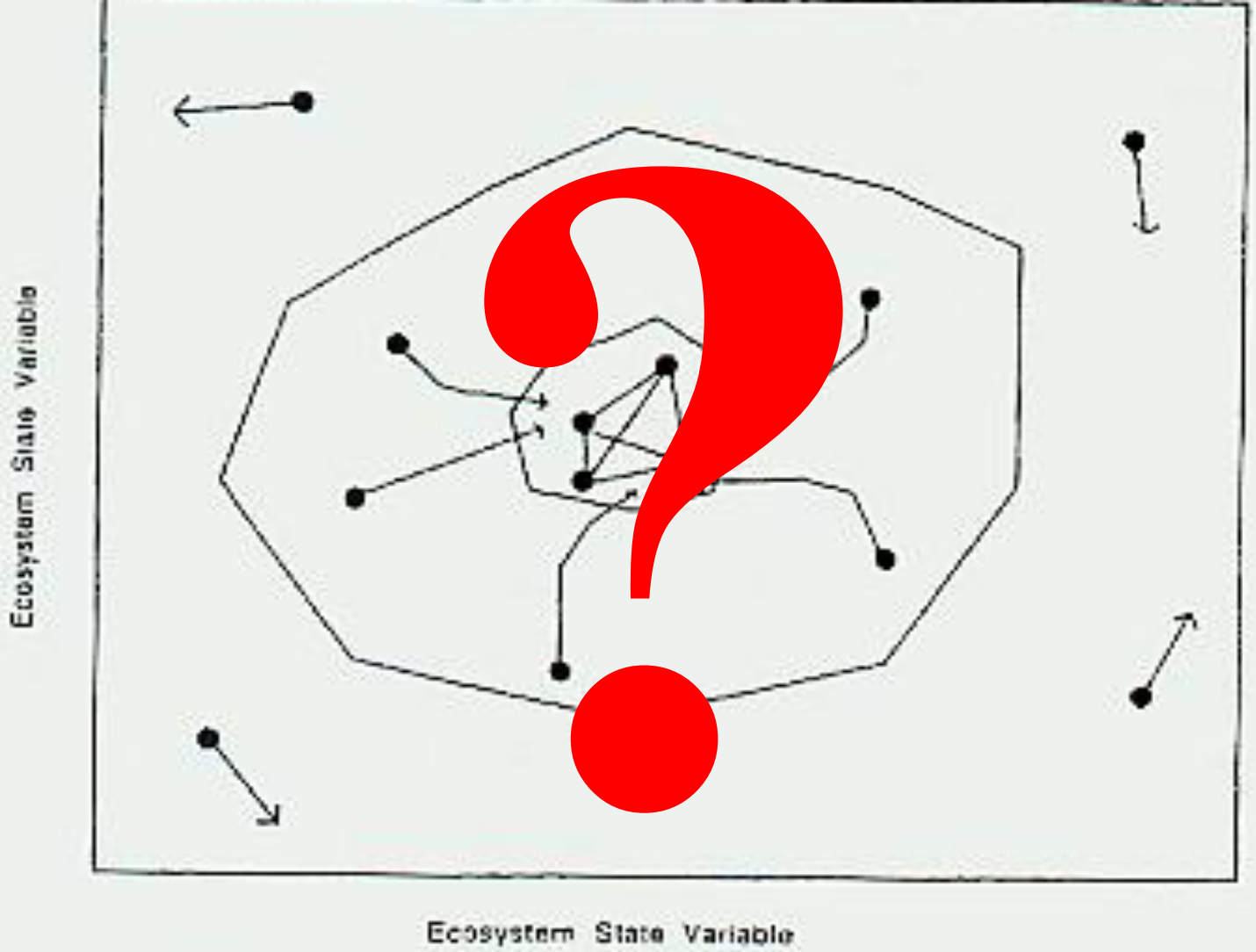

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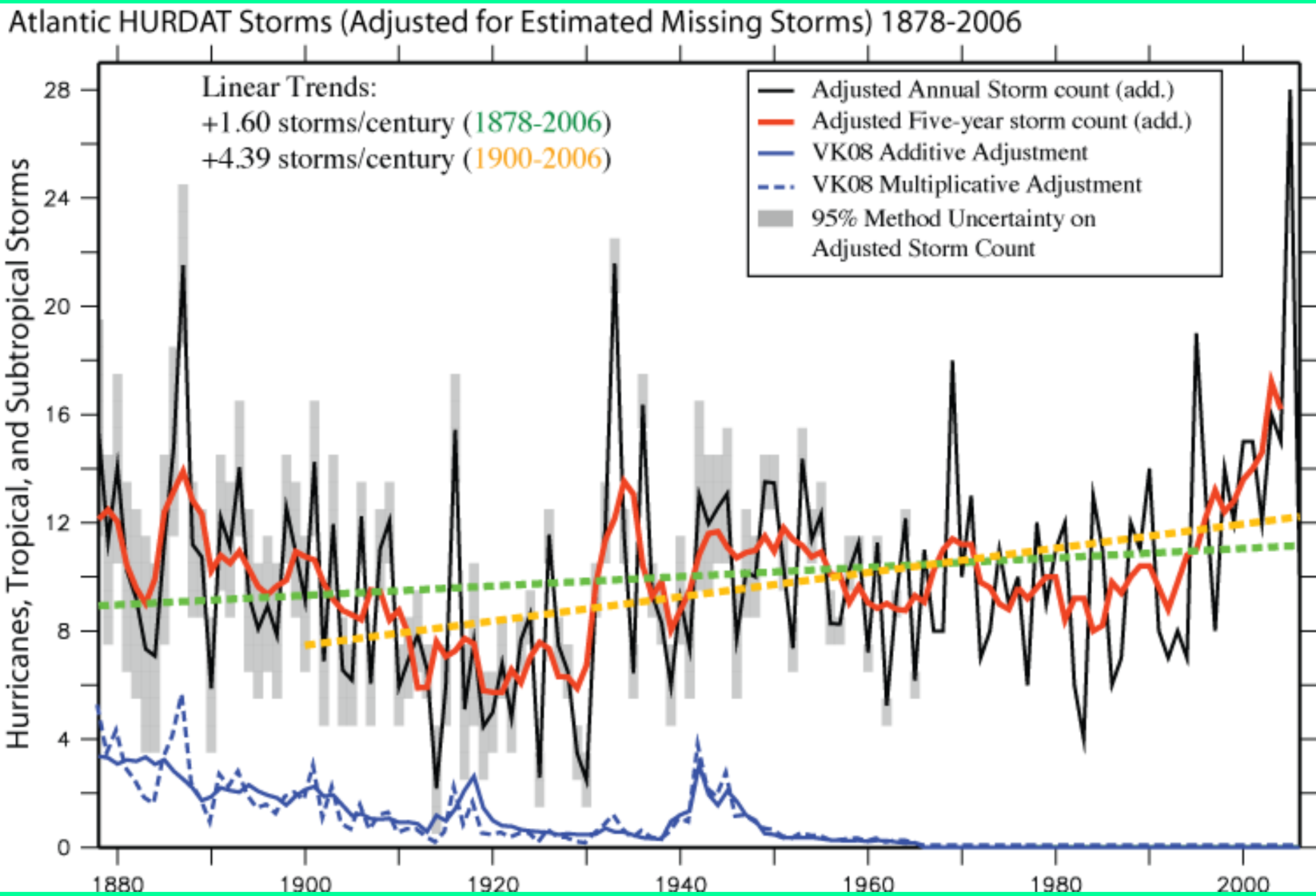
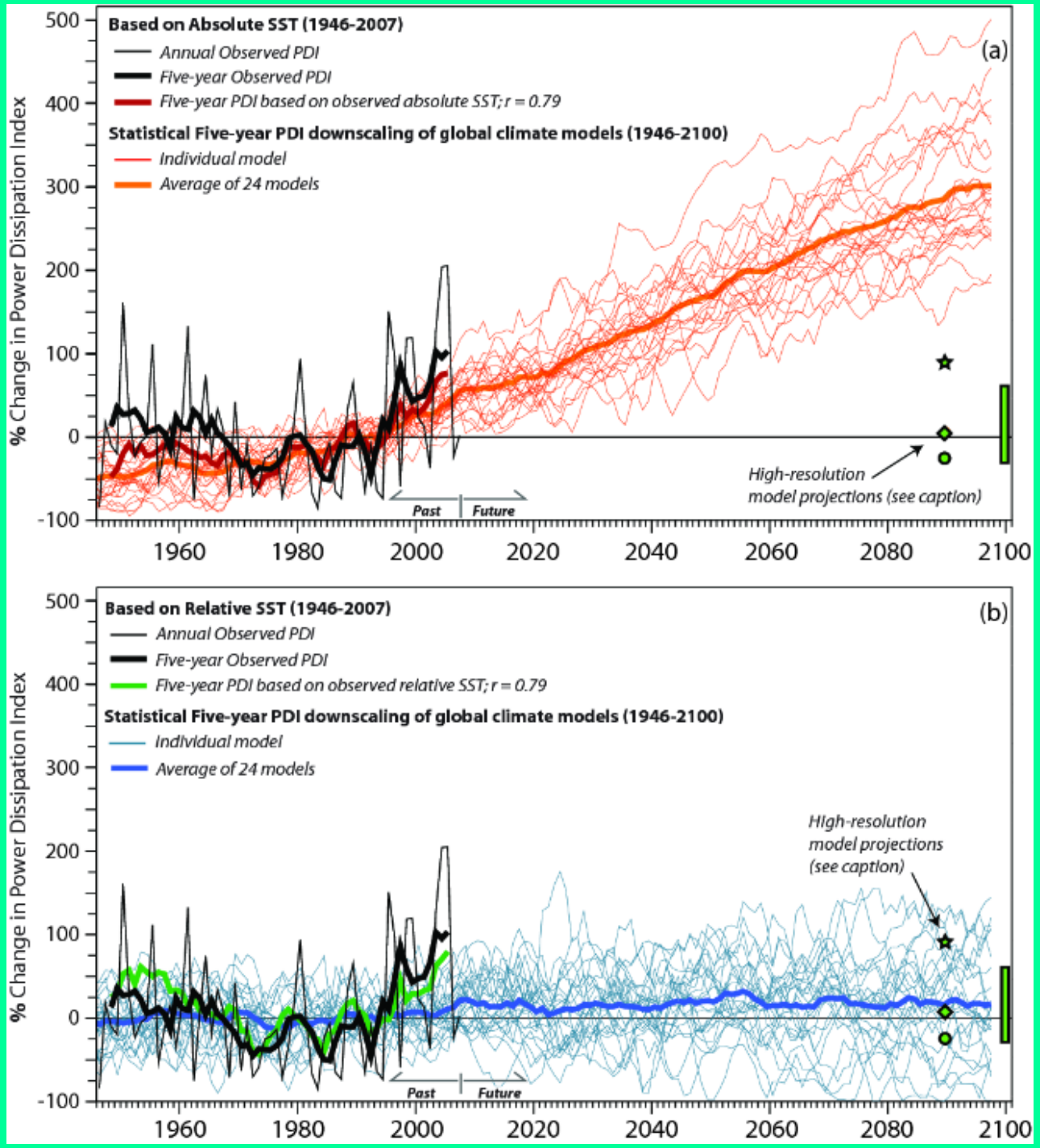
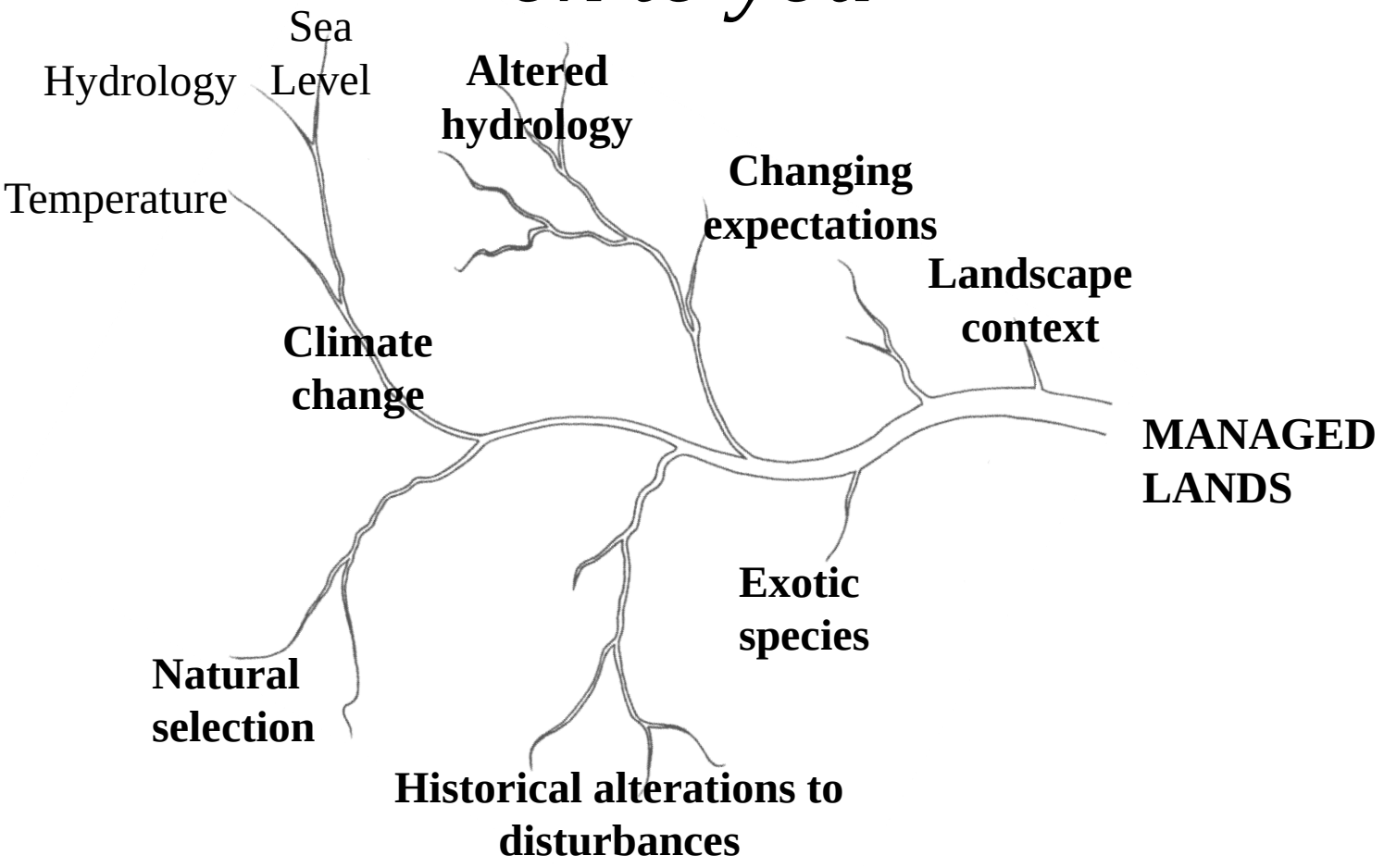

Atlantic HURDAT Storms (Adjusted for Estimated Missing Storms) 1878-2006
Linear Trends:
+1.60 storms/century (1878-2006)
+4.39 storms/century (1900-2006)
Adjusted Annual Storm count (add.)
Adjusted Five-year storm count (add.)
VK08 Additive Adjustment
VK08 Multiplicative Adjustment
95% Method Uncertainty on Adjusted Storm Count
Hurricanes, Tropical, and Subtropical Storms
0
4
8
12
16
20
24
28
1880
1900
1920
1940
1960
1980
2000


Based on Absolute SST (1946-2007)
Annual Observed PDI
Five-year Observed PDI
Five-year PDI based on observed absolute SST; r = 0.79
Statistical Five-year PDI downscaling of global climate models (1946-2100)
Individual model
Average of 24 models
(a)
% Change in Power Dissipation Index
500
400
300
200
100
0
-100
1960
1980
2000
2020
2040
2060
2080
2100
Past
Future
High-resolution model projections (see caption)
Based on Relative SST (1946-2007)
Annual Observed PDI
Five-year Observed PDI
Five-year PDI based on observed relative SST; r = 0.79
Statistical Five-year PDI downscaling of global climate models (1946-2100)
Individual model
Average of 24 models
(b)
% Change in Power Dissipation Index
High-resolution model projections (see caption)
Past
Future

You could not step twice into the same river; for other waters are ever flowing on to you

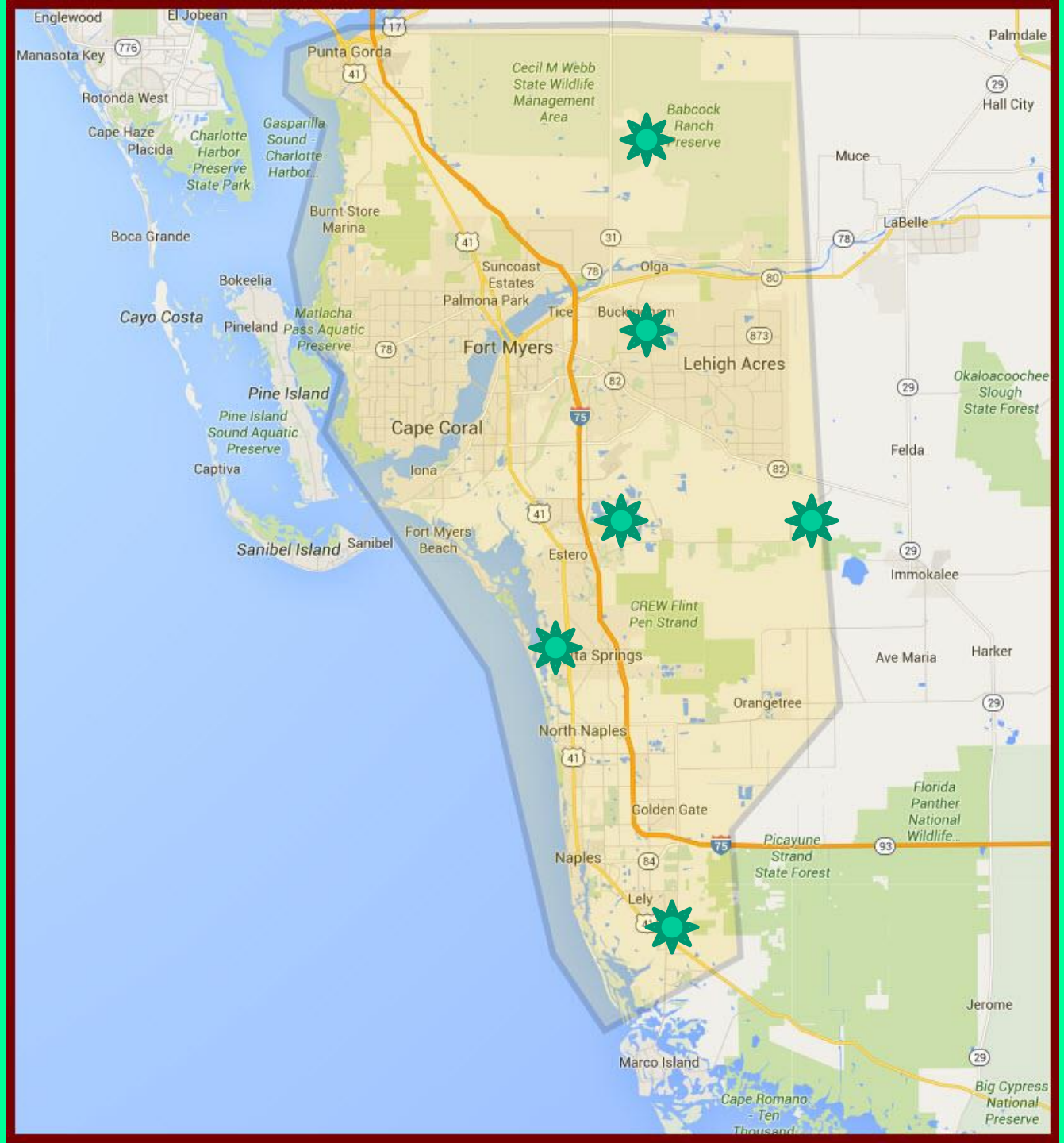


HURRICANE CHARLEY: SIX MONTHS LATER

A land forever altered

ANDREW WEST/THE NEWS-PRESS

■ Clinton Comstock, a resident of Carl Avenue in Punta Gorda, removes Hurricane Charley debris from a pasture behind his home recently. Comstock, who has lived on the street for 25 years, lost his mobile home to the storm and is living in a camper while waiting for a new home. The barbed wire is a remnant of Florida Power & Light.


Englewood
El Jobean
Manasota Key
Punta Gorda
Palmdale
Cecil M Webb State Wildlife Management Area
Hall City
Rotonda West
Babcock Ranch Preserve
Cape Haze
Placida
Charlotte Harbor Preserve State Park
Gasparilla Sound - Charlotte Harbor...
Muce
Burnt Store Marina
LaBelle
Boca Grande
Suncoast Estates
Olga
Bokeelia
Palmona Park
Tice
Cayo Costa
Pineland
Matlacha Pass Aquatic Preserve
Fort Myers
Lehigh Acres
Okaloacoochee Slough State Forest
Pine Island
Pine Island Sound Aquatic Preserve
Cape Coral
Felda
Captiva
Iona
Fort Myers Beach
Sanibel Island
Sanibel
Estero
Immokalee
CREW Flint Pen Strand
Ave Maria
Harker
Orangetree
North Naples
Golden Gate
Florida Panther National Wildlife...
Picayune Strand State Forest
Naples
Lely
Jerome
Marco Island
Big Cypress National Preserve
Cape Romano - Ten Thousand

HERACLITUS OF EPHESUS –

C. 535 – C. 475 BC

"πάντα χωρεῖ καὶ οὐδὲν μένει" καὶ "δὶς ἐς τὸν αὐτὸν ποταμὸν οὐκ ἂν ἐμβαίης“
Plato’s *Cratylus*

- *No man ever steps in the same river twice*
- *You could not step twice into the same river; for other waters are ever flowing on to you.*
- *All entities move and nothing remains still"*
- *Nothing is permanent except change*

Pascal's Wager

	Believe	Do not believe
God exists		
God does not exist		

Pascal's Wager

	Believe	Do not believe
God exists	Heaven	
God does not exist		No loss or gain

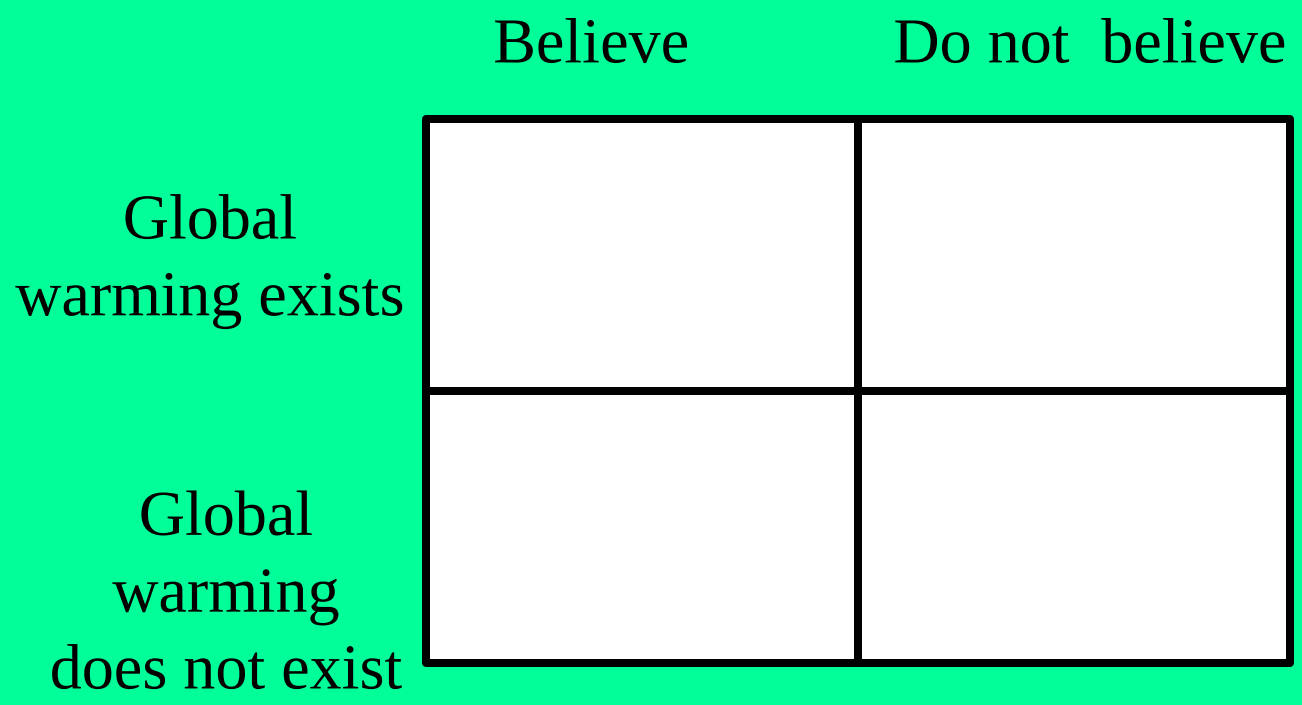
Pascal's Wager

	Believe	Do not believe
God exists	Heaven	Hell
God does not exist		No loss or gain

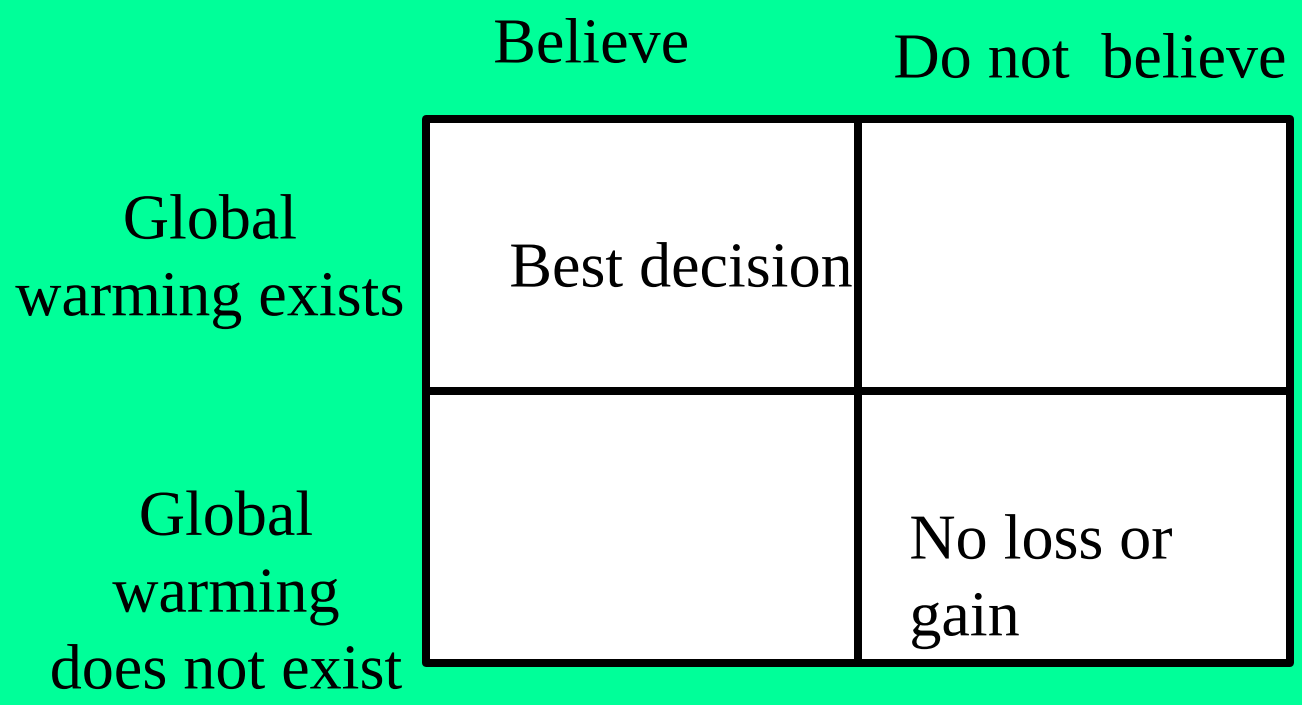
Pascal's Wager

	Believe	Do not believe
God exists	Heaven	Hell
God does not exist	Live a good life	No loss or gain

Everham's Wager



Everham's Wager



Everham's Wager

	Believe	Do not believe
Global warming exists	Best decision	Hell on earth
Global warming does not exist		No loss or gain

Everham's Wager

	Believe	Do not believe
Global warming exists	Best decision	Hell on earth
Global warming does not exist	sustainable life	No loss or gain